# Hydrogeology and Groundwater Quality

# Young Nak Retreat Center,

# Lake Hughes, California

*Prepared by:*


IWR

INTEGRATED WATER RESOURCES, INC

SANTA BARBARA, CALIFORNIA

(805) 966-7757

integratedwater.com



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# INTRODUCTION

This report summarizes hydrogeologic conditions, and estimates changes to groundwater quality and quantity that would be caused by proposed site improvements at the Young Nak Christian Retreat Center ("Center") in Lake Hughes, California. Proposed improvements at the Center are expected to accommodate as many as 300 summer weekend visitors.

Based upon the analysis provided herein, no significant impacts to groundwater, water quality or the riparian wetland habitat are anticipated.

# EXISTING CONDITIONS

## *Groundwater Hydrology*

The Center is located at 24100 Pine Canyon Road near Lake Hughes, California (Figure 1). The single most important geologic feature at the site is the San Andreas Fault, which runs along the northeast edge of the property from the southeast to the northwest. The combination of the fault on the northeast and the mountains to the southwest creates unique hydrogeologic conditions at the site. Relatively larger quantities of precipitation at higher elevations in the mountains recharge the regional groundwater aquifer. Groundwater gradients are from higher elevations to lower, but the San Andreas Fault acts as a relatively impermeable barrier to groundwater flow. At the Center property this results in groundwater gradients that likely flow from the southwest to the northeast, and results in relatively shallow groundwater on the up-gradient side of the San Andreas Fault as flow is hindered.

Potable water is supplied by a groundwater well that was present when the property was purchased. The well is 110 feet deep. Information on subsurface lithology at the site is limited, because of the lack of a state well driller's report and lithologic log for the well on the property. Percolation tests conducted by Professional Geotechnical Consultants, Inc. in February of 2006 provide additional information on soil and shallow alluvial sediment properties, to depths of approximately 15-20 feet below ground surface.

Integrated Water Resources, Inc. ("IWR") conducted a pumping test of the groundwater production well at the Young Nak Center on April 20, 2006. The purpose of the pumping test was to obtain data on aquifer properties, in order to estimate the effect of longer term sustained pumping rates required to provide water supply for the planned expanded facilities at the Center. This 4.8 hour pumping test averaged 17 gallons per minute (gpm), and represents the maximum sustainable rate of the pump (see Figure 2 and Table 1 for test data). Total drawdown in the well at the end of the test was 3.1 feet. This drawdown level had not changed for the last 1.5 hours of the test.

A water sample for water quality analysis was collected near the end of the pumping test. This sample was collected at the well-head and upstream of the chlorination and filtration system. The results of this analysis are provided below in the Groundwater Quality section of this report.

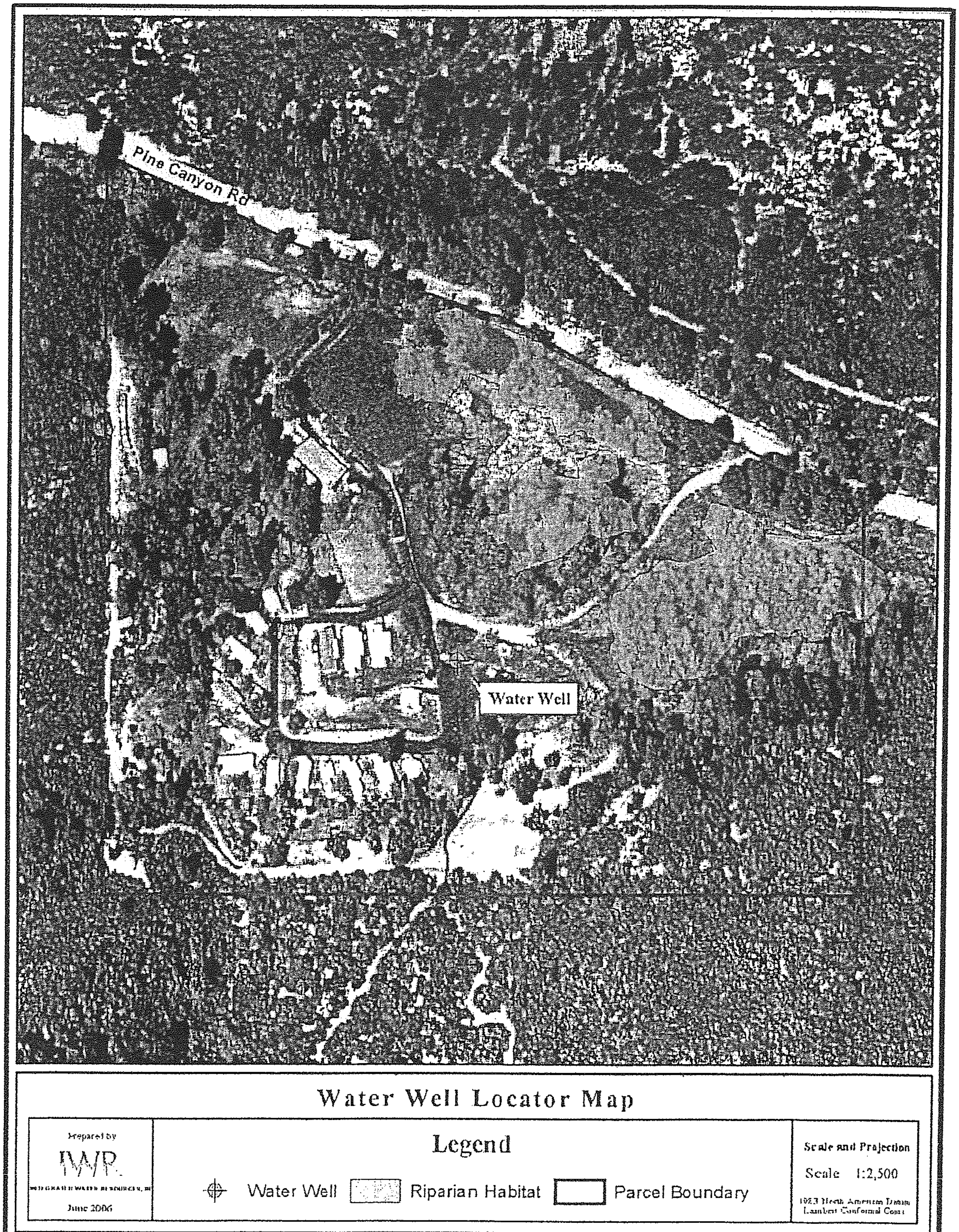



Figure 1. Map of Young Nak Retreat Center illustrating property boundary, riparian habitat and location of water supply well.

Table 1. Pumping Test Data – Young Nak Center, Lake Hughes, CA – April 20, 2006

| Elapsed Time (minutes) | Depth to Water (in feet, at top of casing) | Pumping Rate (gpm) |
|---|---|---|
| 0 | 4 | |
| 1 | 5.2 | |
| 2 | 5.4 | 31 |
| 3 | 5.5 | 2 |
| 4 | 5.5 | 6 |
| 5 | 5.5 | 6 |
| 7 | 5.5 | 9 |
| 10 | 4.1 | |
| 13 | 5 | |
| 14 | 5.1 | 6 |
| 15 | 5.3 | |
| 20 | 5.5 | |
| 25 | 5.6 | 23 |
| 30 | 5.7 | 19 |
| 35 | 5.75 | 19 |
| 40 | 5.8 | 18 |
| 48 | 5.85 | 16 |
| 50 | 5.87 | 28 |
| 65 | 5.9 | 18 |
| 80 | 5.92 | 19 |
| 95 | 5.95 | 19 |
| 110 | 5.98 | 19 |
| 125 | 6 | 18 |
| 140 | 6.25 | 19 |
| 155 | 6.5 | 19 |
| 170 | 6.7 | 18 |
| 188 | 6.9 | 19 |
| 200 | 7.1 | 15 |
| 215 | 7.1 | 18 |
| 230 | 7.1 | 19 |
| 245 | 7.1 | 18 |
| 260 | 7.1 | 19 |
| 275 | 7.1 | 18 |
| 290 | 7.1 | 13 |

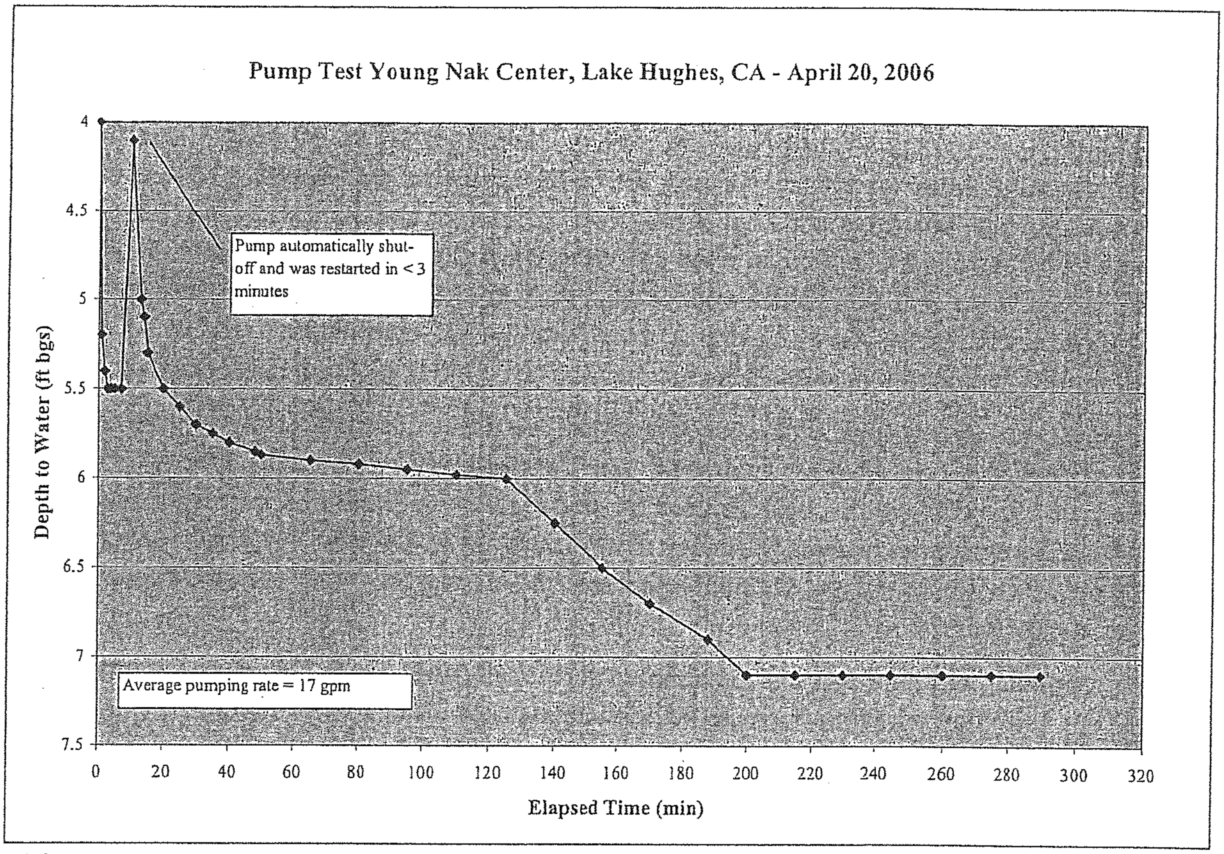



Figure 2. Graph of drawdown vs. elapsed time for pumping test.

## *Aquifer Characteristics and Analysis*

Determination of the local aquifer characteristics is conducted for the purpose of evaluating the magnitude and extent of aquifer drawdown, the "cone of depression", resulting from existing and proposed groundwater extractions. A fundamental parameter that supports this effort is known as the aquifer "transmissivity". The value calculated for this term provides a measure of the ease which groundwater will flow to the well. A high transmissivity corresponds with a greater flow rate of groundwater to the well for a given amount of drawdown. Likewise, a lower transmissivity indicates that a lesser flow rate will result for that same amount of drawdown.

In unconfined aquifers such as the one underlying the Center, transmissivity can be calculated using an empirical relationship based upon "specific capacity" of the well. Specific capacity is defined as the yield of the well divided by the drawdown measured corresponding to the equilibrated water level reached following steady pumping at the well's typical production rate. Based on data collected during the pumping test at the Young Nak well, specific capacity of the aquifer is 5.5 gpm/ft.

Using this data, and an empirical relationship developed by Driscoll [Groundwater and Wells, 1986; app 16D], the transmissivity can be calculated as specific capacity (in units of: gpm per ft of drawdown) x 1500. Based on the specific capacity calculated above, transmissivity for the aquifer is calculated to be approximately 8,000 gpd/ft.

This calculated value is consistent with an independent approach to calculating transmissivity based upon the "Hydraulic Conductivity" (similar to the "permeability") of the aquifer. A typical sandy aquifer has a hydraulic conductivity of approximately 100 gpd/ft$^2$. Assuming that the well has 80 feet of perforated casing (110 ft deep minus an approximately 30 ft deep sanitary seal), then the effective aquifer thickness is 80 feet. Using the classic hydrogeologic relationship of transmissivity equating to the aquifer thickness times its hydraulic conductivity yields a transmissivity of approximately 8,000 gpd/ft, consistent with that calculated with the initial method described above.

It is possible that the well yield and aquifer characteristics could be greater or lesser than the conservative assumptions identified above. Minor changes in these values will correspond with inconsequential changes to the drawdown present at large distances (greater than 2,000 ft) from the well. Additionally, because of the groundwater gradient, with higher groundwater elevations in the steep hills south of the well, most of the added drawdown would be in that direction where a relatively small increase in drawdown will correspond with a large increase in groundwater flowing to the well. This difference in the aquifer yield from up-gradient areas compared with down-gradient, lower elevation areas will result in an asymmetrical, oval-shaped cone of depression with a long axis trending southwest-northeast. Importantly, the presence of higher groundwater elevations south of the well will correspond with the majority of the groundwater extracted from the well being derived from those areas, which is lessens the actual drawdown associated on the more shallowly sloping areas to the north of the well and nearer to the proposed septic system discharge area.

Riparian wetland habitat is present at the sag ponds associated with the San Andreas Fault located, at its nearest point, approximately 180 feet away and at nearly 40 feet lower elevation from the well site. These sag ponds likely represent a surface exposure of the groundwater table, and therefore, it is important to investigate the relationship of pumping at the Center's well on water levels at these sag ponds. Historical water production (see below) has been a fraction of the pumping capacity of the well, and likely has resulted in no sustained groundwater depression. It is unlikely, even at maximum historical pumping rates, that groundwater pumping has affected water levels associated with the sensitive wetland habitat.

## *Groundwater Quality*

The water quality sample collected near the end of the pumping test provided data indicating that groundwater quality is very good, and is considerably better than drinking water standards as listed by the California Department of Health Services Title 22 regulations. In all cases, the concentrations of various parameters detected in the water sample from the property's water well substantially lower than the corresponding primary or secondary Maximum Contaminant Level (MCL) indicating clear compliance with these regulatory limits.

Table 2. Water Quality Data – Young Nak Retreat Center, Lake Hughes, CA

| SAMPLE DATE | ANALYTE | RESULT | DL | PRIMARY MCL | SECONDARY MCL | UNITS |
|---|---|---|---|---|---|---|
| 04/20/06 | Aluminum | ND | 0.5 | 1000 | 200 | ug/l |
| 04/20/06 | Arsenic | 0.2 | 0.1 | 50 | | ug/l |
| 04/20/06 | Barium | 6.4 | 0.05 | 1000 | | ug/l |
| 04/20/06 | Bicarbonate Alkalinity | 134 | 0.6 | | | mg/l |
| 04/20/06 | Cadmium | ND | 0.07 | 5 | | ug/l |
| 04/20/06 | Calcium | 36.2 | 0.005 | | | mg/l |
| 04/20/06 | Carbonate Alkalinity | ND | 0.6 | | | mg/l |
| 04/20/06 | Chloride | 32.2 | 0.07 | | 500 | mg/l |
| 04/20/06 | Chromium | 0.7 | 0.09 | 50 | | ug/l |
| 04/20/06 | Color | 9.0 | 1.0 | | | Color Units |
| 04/20/06 | Copper | 0.3 | 0.06 | | 1000 | ug/l |
| 04/20/06 | Fecal Coliforms | ND | 1.0 | | | MPN/100 ml |
| 04/20/06 | Fluoride | 0.59 | 0.01 | | | mg/l |
| 04/20/06 | Hydroxide Alkalinity | ND | 0.6 | | | mg/l |
| 04/20/06 | Iron | 0.04 | 0.007 | | 0.3 | mg/l |
| 04/20/06 | Lead | ND | 0.07 | | 15 | ug/l |
| 04/20/06 | Magnesium | 8.24 | 0.01 | | | mg/l |
| 04/20/06 | Manganese | 0.7 | 0.3 | | 50 | ug/l |
| 04/20/06 | MBAS | ND | 0.05 | | 0.5 | mg/l |
| 04/20/06 | Mercury | ND | 0.05 | 2 | | ug/l |
| 04/20/06 | Nitrate as NO3 | 0.84 | 0.02 | 45 | | mg/l |
| 04/20/06 | Odor | ND | 0.1 | | 3 | T.O.N. |
| 04/20/06 | pH | 6.4 | 0.1 | | | pH Units |
| 04/20/06 | Potassium | 1.49 | 0.06 | | | mg/l |
| 04/20/06 | Selenium | ND | 0.1 | 50 | | ug/l |
| 04/20/06 | Silver | ND | 0.06 | | 100 | ug/l |
| 04/20/06 | Sodium | 13.8 | 0.51 | | | mg/l |
| 04/20/06 | Specific Conductance (EC) | 322 | 0.05 | | 900 | umhos/cm |
| 04/20/06 | Sulfate as SO4 | 44.8 | 0.02 | | 500 | mg/l |
| 04/20/06 | Total Alkalinity | 134 | 0.6 | | | mg/l |
| 04/20/06 | Total Anions | 3.4 | | | | NA |
| 04/20/06 | Total Cations | 3.1 | | | | NA |
| 04/20/06 | Total Coliforms | ND | 1.0 | | | MPN/100 ml |
| 04/20/06 | Total Dissolved Solids | 213 | 0.2 | | 1000 | mg/l |
| 04/20/06 | Total Hardness | 132 | 0.8 | | | mg/l |
| 04/20/06 | Turbidity | 0.9 | 0.002 | | 5 | NTU |
| 04/20/06 | Zinc | 5.1 | 0.3 | | 5000 | ug/l |

**The groundwater quality sample was collected after > 4 hours of continuous well pumping at an average rate of 17 gpm. Samples were collected immediately above the wellhead, upstream of the filtration and chlorination systems. DL=Detection Limit; MCL=Maximum Contaminant Level.*

### *Historical Groundwater Use*

The Young Nak water supply well currently provides all water needs for the Center. Records indicate that in 2004 total pumping was 1,004,100 gallons (3.1 acre-feet), and in 2005 total pumping was 1,550,662 gallons (4.8 acre-feet). Over this same two year period winter time average daily consumption ranged from 1 gpm to 2 gpm (1,440-2,880 gpd), and summer average daily consumption ranged from 2.25 gpm to 5 gpm (3,240-7,200 gpd). This range, from winter to summer, directly reflects the number of visitors to the center, with summer weekend retreats representing maximum occupancy and consumption rates. The maximum average summertime pumping rate of 5 gpm is only 30% of the pumping capacity of the existing groundwater pump.

As demonstrated by the sustained pumping test at 17 gpm that produced 3.1 feet of drawdown over 4.8 hours, the existing water supply well has been able to provide potable water for the Center without any long term stress to the aquifer.

## ANALYSIS OF PROPOSED CONDITIONS

An analysis of the effects of project implementation is discussed for each of the criteria identified below.

### *Proposed Changes in Groundwater Consumption*

It is anticipated that the annual groundwater pumping after the project improvements are implemented will increase the current average groundwater pumping rate of approximately 4,000 gallons per day (or 4.4 acre-feet per year) to an annual average of 16,000 gallons per day (or 17.4 acre-feet per year). Analytical results of the affect of this increased average annual pumping rate (11 gpm for 1 year) are provided in Figure 3. Total drawdown at the property edge, assuming a circular cone of depression, would be less than 1 foot. This is a conservative analysis because it does not take into account the fact that the wastewater disposal system will be percolating nearly this entire pumped amount back into the aquifer which will tend to diminish the drawdown effect from the well pumping.

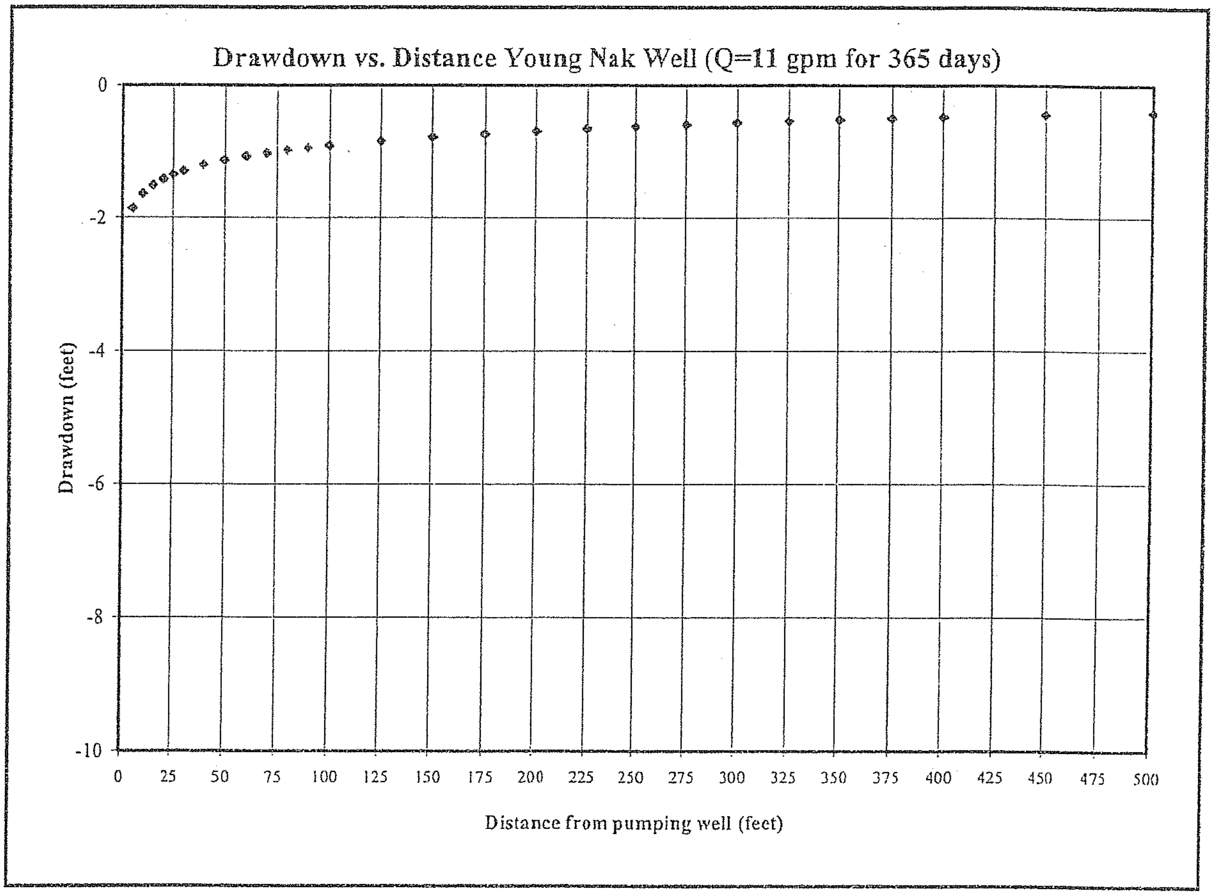



Figure 3. Graph illustrating drawdown for expected average annual pumping rate after Center improvements.

After implementation of the proposed project improvements, it is estimated that as many as 300 people may be at the site during peak summer weekends. The maximum rate of wastewater production, as calculated using industry standards by WREA (See WREA Wastewater Collection and Disposal System report dated October 27, 2006), is 19,500 gallons per day, or 13.5 gpm. This corresponds to the high use summer weekends.

Because the majority of the additional water will be used to support the presence of a larger number of guests at the site through the increased use of water in the kitchens, toilets, and showers, almost all of this additional water will be captured by the septic system and subsequently conveyed back to the aquifer via the leach line systems. Because the water returns to the aquifer, there will be very limited "consumptive use" (i.e., net removal of water from the aquifer). Therefore, the net change in total groundwater at the Center will be negligible.

The maximum wastewater production rate can be considered to represent the likely groundwater supply rate required for the high use summer weekends, or 13.5 gpm. The existing groundwater well is capable of producing, for sustained periods, 17 gpm or 24,500 gallons per day, which provides a 20% additional capability over anticipated peak demand. In addition, the Center may install additional water supply storage to support the high use weekends and reduce demand on the water well. The presence of greater water supply storage will allow for lower, but more sustained, pumping rates over the summer months, which will minimize any affects on groundwater levels.

Utilization of water conservation measures including such measures as the installation of waterless urinals, and low-flow toilets and showerheads and educational measures for visitors, will serve to minimize water supply needs and groundwater extraction at the site.

## *Proposed Changes in Groundwater Use and Effects on Groundwater Table*

As stated above, the majority of the pumped groundwater will be discharged back to the aquifer following conveyance and treatment by the septic system. Therefore, long term changes to the regional groundwater table will be minimal as a result of the proposed increased pumping.

Increased pumping rates associated with the proposed project will create a larger groundwater depression in the vicinity of the water well during the periods (primarily the summer months) corresponding with the increased water demand. Based upon the aquifer characteristics calculated in the "Aquifer Characteristics and Analysis" section of this report, an analysis of the average effect of using a sustained maximum pumping rate (17 gpm) for an extended period (30 days) indicates that total drawdown will be less than 1 foot at a distance of 100 feet from the well, and less than half a foot at the distance of the wetlands (Figure 4). In addition, as stated above, the groundwater depression will likely be considerably asymmetric. This asymmetry is generated from the steep terrain to the south of the well, the source of the majority of the well's groundwater supply, compared to the relatively flat terrain near to and north of the well. This asymmetry will tend to lessen the anticipated drawdown in the riparian wetlands area.

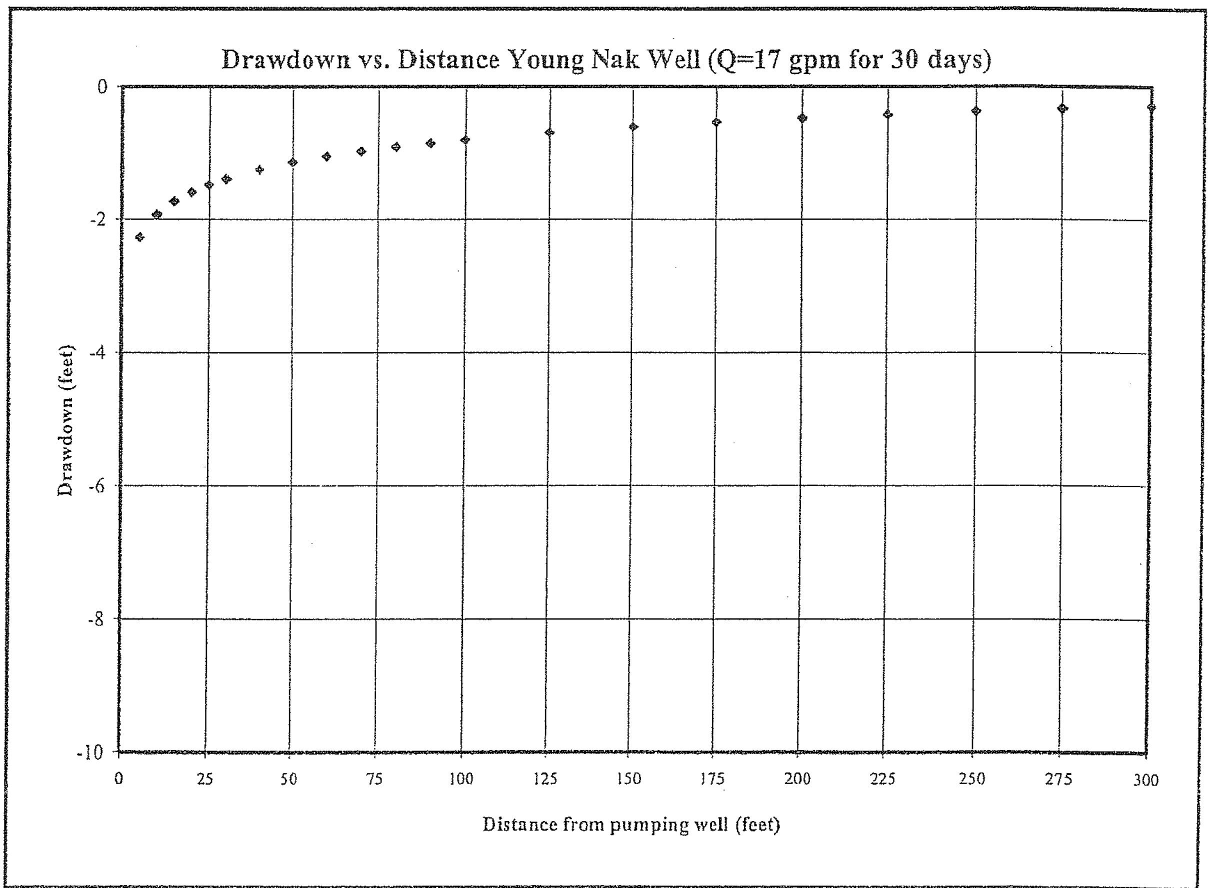



Figure 4. Plot of drawdown curve for sustained maximum pumping during summertime peak-use periods following the proposed improvements.

## *Proposed Changes in Groundwater Use and Effects on Quality of Extracted Groundwater*

Current water quality tests do not indicate any influence from the existing septic leach fields at the site. Bacteria were not detected in the groundwater sample collected in April of 2006 (< 1.1 MPN per 100 mL) and nitrate was detected at concentrations of 0.84 mg/l (significantly lower than the primary drinking water maximum contaminant level of 45 mg/l) and likely representative of background conditions.

The existing leach field near the restroom east of the well is of greatest interest in terms of the quality of extracted groundwater. The exact location and elevation of this leachfield is unknown, and additional information on leachfield location would be required to determine possible interference with the cone of depression created by pumping at the water supply well. Additional sampling conducted shortly after a high-use summer weekend is also recommended if continued use of this existing septic system is considered. If the location of this leachfield is found to be within the potential capture zone of the well, then use of this system must be discontinued to protect the quality of extracted groundwater. A new wastewater collection and disposal system (WREA, October 17, 2006) has been conceptually designed for the expanded Center and it is expected that the existing septic systems will be abandoned.

The new septic system being designed is several hundred feet away, at approximately the same elevation as the water supply well (WREA, October 17, 2006). This preliminary placement meets Los Angeles County Department of Health Services requirements of a minimum 100 feet separation of leachfield and water supply wells.

## *Proposed Changes in Groundwater Use and Effects on Water Quality of Riparian Areas*

The proposed changes in groundwater use will not likely affect the quality of the groundwater reaching the riparian areas from the septic system, provided that the following conditions, which are fundamental to the conceptual design documented in the WREA report, are met:

- All septic flows at the site are routed to properly sized leach systems designed to accommodate the anticipated peak flow volume on summer weekends.
- All septic flows are routed to a system designed to provide a minimum of 10 ft separation between the leach lines and the historic high groundwater levels.
- All septic leach fields are located at a minimum distance of 50 ft from the boundary of a riparian area.

The Wastewater Collection and Disposal System Report by WREA (October 17, 2006) sets out several permit requirements for on-site wastewater treatment systems, which when implemented will ensure there will be no water quality impacts on groundwater or Riparian Areas. In particular, we concur with the evaluation and likely inclusion of two important aspects of the proposed system: namely the specialized treatment approaches that can reduce the effluent's nitrate concentrations and the installation of strategically-location monitoring wells). These components can be of particular benefit in safeguarding and tracking water quality changes over time.

YOUNG NAK CHRISTIAN RETREAT CENTER
Lake Hughes, CA

## DOMESTIC WATER SYSTEM REPORT

## MAXIMUM DAY WATER USAGE CALCULATIONS

| *Description* | *People Quantity/Day*[2] | *Unit Usage GPD*[6] | *Max. Wknd. DayUsage G* |
|---|---|---|---|
| Overnight Guest in Dormitory | 96 | 62.5 | 6000 |
| Overnight Guest in Cottages (Mobile Homes) | 120 | 75 | 9000 |
| Daytime Attendee | 28* | 25 | 700 |
| Caretaker | 2 | 125 | 250 |
| Daytime Staff (Commuting) | 4 | 25 | 100 |
| Cafeteria/Dining Hall | 750 meals/day | 8.75 | 6562.5 |
| **Sub Total Domestic Individual Uses = 22,612.5** | | | |

**22,612.5 MDD**

*Population variations will range from the two to three, year round, resident staff members, to maximum 250 total visitors at any one time during the months of July and August.

2 Population figures provided by Mr. Jay Kim, email correspondence dated February 6, 2008. Maximum day population is 250 ppl.

6 Flow rates for domestic unit usage GPD were calculated by multiplying wastewater flows by a factor of 1.25. The wastewater flows are based on accepted engineering standards adapted from 2007 California Plumbing Code, Table K-3 & Wastewater Engineering, Treatment and Re-Use, 4th Edition, Tables 3-2 through 3-4, Metcalf & Eddy, 2003

YOUNG NAK CHRISTIAN RETREAT CENTER
Lake Hughes, CA

## DOMESTIC WATER SYSTEM REPORT

## PLUMBING FIXTURE LIST

| Description | Appliance | # Of Fixtures | Private FU Weight | Total FU Demand |
|---|---|---|---|---|
| **Chapel Building** | | | | |
| | Water Closet | 4 | 3 | 12 |
| | Lavatory | 4 | 1 | 4 |
| **Cafeteria** | | | | |
| *Kitchen* | Utility Sink | 3 | 4 | 12 |
| | Commercial Dishwasher | 1 | 4 | 4 |
| *Restroom* | Water Closet | 10 | 3 | 30 |
| | Urinals | 3 | 2 | 6 |
| | Lavatory | 6 | 1 | 6 |
| **Pool area** | | | | |
| *Restroom* | Water Closet | 6 | 3 | 18 |
| | Urinals | 3 | 2 | 6 |
| | Lavatory | 4 | 1 | 4 |
| | Shower | 4 | 2 | 8 |
| **Dormitory** | | | | |
| | Water Closet | 24 | 3 | 72 |
| | Shower | 24 | 2 | 48 |
| | Lavatory | 48 | 1 | 48 |
| | Kitchen Sink | 1 | 1.5 | 1.5 |
| | Clothes Washer | 2 | 4 | 8 |
| **Small Meeting** | | | | |
| | Water Closet | 2 | 3 | 6 |
| | Lavatory | 2 | 1 | 2 |
| **Mobile Dwelling Units** | | | | |
| | Kitchen Sink | 11 | 1.5 | 16.5 |
| | Lavatory | 19 | 1 | 19 |
| | Water Closet | 19 | 3 | 57 |
| | Shower | 19 | 2 | 38 |
| **Caretaker Residence** | | | | |
| | Kitchen Sink | 1 | 1.5 | 1.5 |
| | Lavatory | 2 | 1 | 2 |
| **Structure Near Caretaker Residence Pending CUP Approval** | | | | |
| | Lavatory | 7 | 1 | 7 |
| | Water Closet | 7 | 3 | 21 |
| **Rest Rooms Near Outdoor Amphitheatre** | | | | |
| | Lavatory | 5 | 1 | 5 |
| | Water Closet | 8 | 3 | 24 |
| | Shower | 6 | 2 | 12 |

YOUNG NAK CHRISTIAN RETREAT CENTER
Lake Hughes, CA

## DOMESTIC WATER SYSTEM REPORT

## PUBLIC USE- FIXUTE UNIT ANALYSIS

| FIXTURE TYPE | GENERAL USE[3] | | HEAVY-USE ASSEMBLY[4] | | TOTAL |
|---|---|---|---|---|---|
| | WEIGHT[1] | NO. FIXTURES | WEIGHT[1] | NO. FIXTURES | |
| Bar Sink | 2 | | - | | |
| Bidet | - | | - | | |
| Clinic Sink | 8 | | - | | |
| Clothes Washer | 4 | 2 | - | | 8 |
| Dental Unit, cuspidor | 1 | | - | | |
| Dishwasher | 1.5 | 1 | - | | 1.5 |
| Drinking Fountain | 0.5 | | 0.75 | | |
| Hose Bibb | 2.5 | | - | | |
| Hose Bibb (each additional) | 1 | | - | | |
| Ice Maker | 2 | | - | | |
| Kitchen Sink | 1.5 | 16 | - | | 24 |
| Laundry Sink | 2 | | - | | |
| *Lavatory* | 1 | 97 | 1 | | 97 |
| Lawn Sprinkler | 1 | | - | | |
| Mobile Home, each | - | | - | | |
| *Shower / Tub* | 2 | | - | | |
| Shower, continuous | 5 | 53 | - | | 265 |
| Urinal Flush Tank | 3 | | 4 | | |
| Urinal, 1.0 GPF | 4 | 6 | 5 | | 24 |
| Urinal, greater than 1.0 GPF | 5 | | 6 | | |
| Utility Sink | 3 | | - | | |
| Wash fountain, circular spray | 4 | | - | | |
| Wash-up Sink, each set of faucets | 2 | | - | | |
| Water Closet | 5 | 80 | 8 | | 400 |
| Water Closet 1.6 GPF Flushometer Tank | 2.5 | | 3.5 | | |
| Water Closet 1.6 GPF Flushometer Valve | 5 | | 8 | | |
| Water Closet, 1.6 GPF Gravity Tank | 2.5 | | 4 | | |
| Water Closet, 3.5 GPF Gravity Tank | 5.5 | | 7 | | |
| Water Closet, 3.5 GPF Flushometer Valve | 8 | | 10 | | |
| Whirlpool Bath or Combination Bath/Shower | - | | - | | |
| | | | | **TOTAL FIXTURE UNITS =** | 819.5 |

YOUNG NAK CHRISTIAN RETREAT CENTER
Lake Hughes, CA

## DOMESTIC WATER SYSTEM REPORT

## PUBLIC USE- FIXUTE UNIT ANALYSIS

**819.5 F. U. =** 182 GPM[2]
(Flush tank)

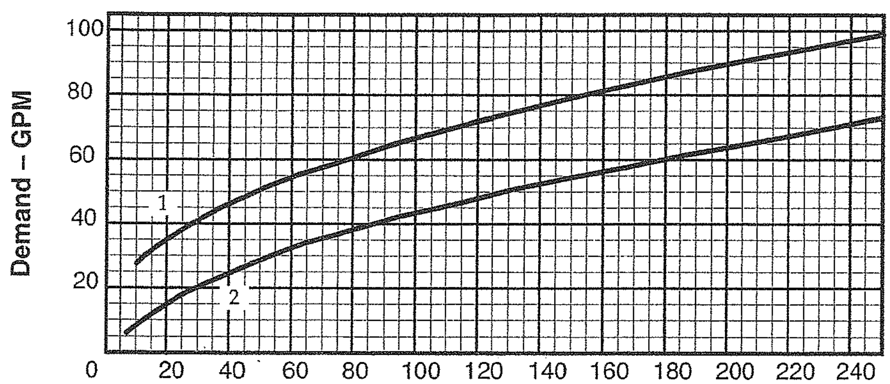
1. Demand weight per Uniform Plumbing Code – Table A-2
2. Uniform Plumbing Code – Demand Charts A-2 & A-3
3. "General use" applies to business, commercial, industrial and assembly occupancies other than those defined under "Heavy-use".
Included are the public and common areas in hotels, motels, and multi-dwelling buildings.
4. "Heavy-use assembly" applies to toilet facilities in occupancies which place a heavy, but intermittent, time-based demand on the water supply system such as schools, auditoriums, stadiums, race courses, transportation terminals, theaters, and similar occupancies where queuing is likely to occur during periods of peak use.

**Prepared by:**

WREA

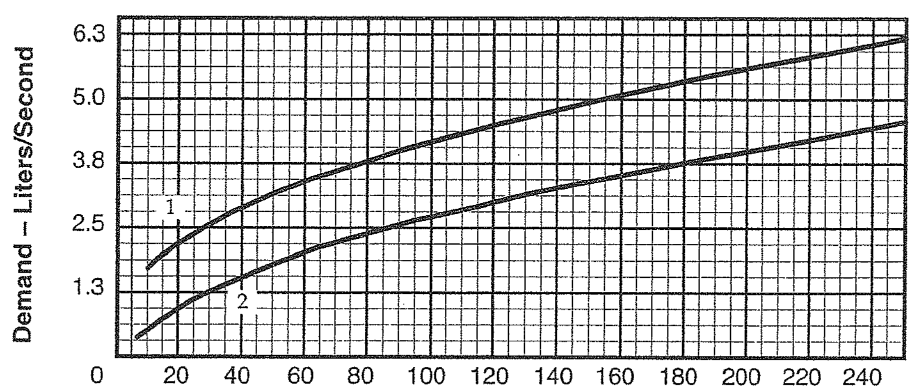
WATER RESOURCE ENGINEERING ASSOCIATES
2300 Alessandro Drive, Suite 215, Ventura, CA 93001
(805) 653-7900 800-25-WATER Fax (805) 653-0610
07/15/08

**Chart A-3**
**Enlarged Scale Demand Load**




**Fixture Units**

**Chart A-3 (Metric)**
**Enlarged Scale Demand Load**




**Fixture Units**

**Chart A-2**
**Estimate Curves for Demand Load**

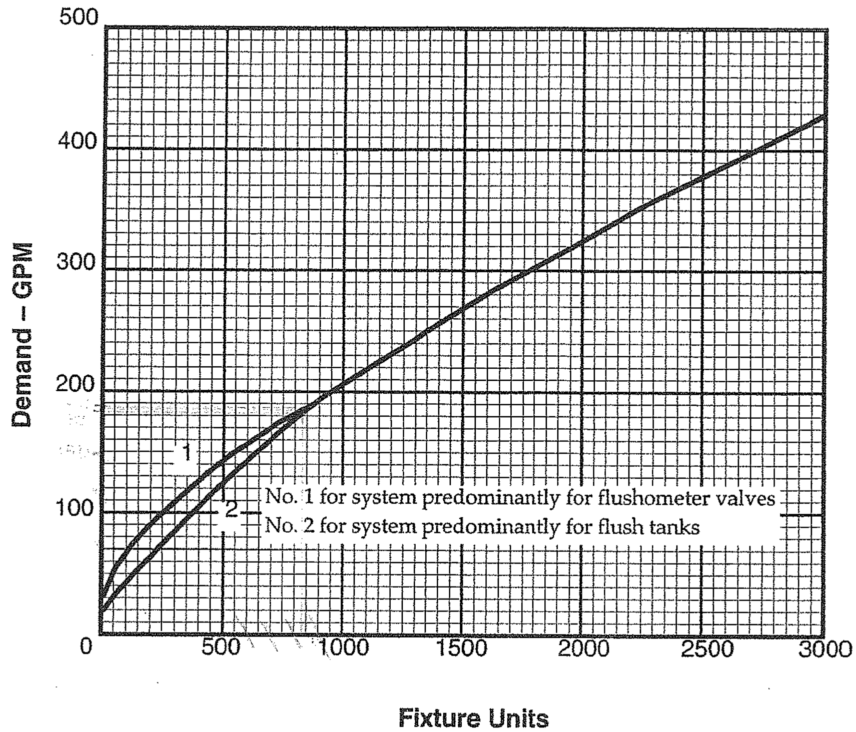



**Chart A-2 (Metric)**
**Estimate Curves for Demand Load**